City of Solana Beach Greenhouse Gas Emissions Inventory and Forecast

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Prepared for the City of Solana Beach

Prepared by the Energy Policy Initiatives Center

ENERGY POLICY INITIATIVES CENTER
UNIVERSITY OF SAN DIEGO SCHOOL OF LAW

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1 INTRODUCTION

This report provides a summary of community-scale greenhouse gas (GHG) emissions from 2010 to 2013 and business-as-usual (BAU) GHG emissions projection for 2020 and 2035 for the City of Solana Beach. This document also describes the methodology used to calculate the 2010 to 2013 GHG emissions by category and BAU GHG emissions from the City of Solana Beach.

Section 2 provides background sources and common assumptions used to estimate GHG emissions. Section 3 provides the results of GHG emissions from the City of Solana Beach from 2010 to 2013. More details on method used in each category, input data, and emission factors are provided in Section 4. The methods used for BAU emission projections are provided in Section 5. Section 6 provided a discussion of the major methodological differences with the previous 2005 inventory.

2 BACKGROUND

2.1 Greenhouse Gases

The primary greenhouse gases (GHGs) included in this inventory are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Each GHG has a different capability of trapping heat in the atmosphere, known as its global warming potential (GWP), which is normalized relative to CO_2 and expressed in carbon dioxide equivalents (CO_2e). In general, the 100-year GWPs reported by the Intergovernmental Panel on Climate Change (IPCC) are used to estimate greenhouse gas emissions. The GWPs used in this inventory are from IPCC Forth Assessment Report (AR4)[1], given in Table 1.

Table 1 Global Warming Potentials Used in the Solana Beach Inventory

Greenhouse Gas	Global Warming Potential (GWP)
Carbon dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous oxide (N_2O)	298

IPCC, 2007

2.2 Categories of Emissions

The U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions published by ICLEI USA (referred to as the ICLEI Community Protocol) recommends including emissions from six categories for a typical community-scale GHG inventory.[2] These categories are: electricity, natural gas, transportation, solid waste, water, and wastewater. GHG emissions are calculated by multiplying activity data (e.g., kilowatt-hours of electricity, tons of solid waste) by an emissions factor. For these categories, methods used in this inventory were based on the ICLEI Community Protocol standard methods, with modifications based on regional- or city-specific data when available.

[1] IPCC Forth Assessment Report: Climate Change 2007. Direct Global Warming Potentials. https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

[2] ICLEI – Local Governments for Sustainability USA. U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. Version 1.0. (2012). http://icleiusa.org/tools/ghg-protocols/

3 SUMMARY OF GHG EMISSIONS

In 2010, the total GHG emissions from the City of Solana Beach were 139,216 metric tons CO_2e (MT CO_2e), distributed into six categories as shown in Figure 1.

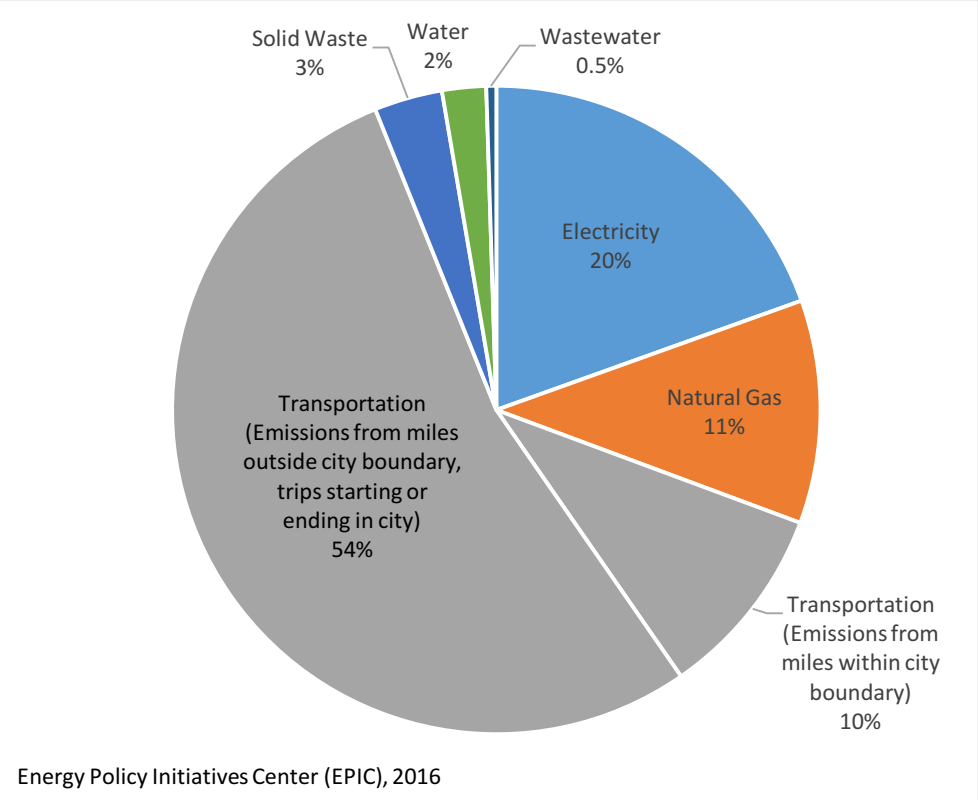


Figure 1 Breakdown of GHG Emissions in City of Solana Beach by Category (2010)

Transportation contributed the most to overall GHG emissions: 10% from trips within the Solana Beach boundary and 54% from trips outside the Solana Beach boundary but starting or ending in the city. Wastewater contributed the least to overall GHG emissions (<1%).

The total GHG emissions from the City of Solana Beach in 2013 were 142,750 metric tons CO_2e (MT CO_2e), 3% higher than the total GHG emissions in 2010, with similar distribution of the categories. The emissions in each category from 2010 to 2013 are presented in Table 2.

Table 2 Breakdown of GHG Emissions by Category from City of Solana Beach (2010 to 2013)

Category	2010	2011	2012	2013
Electricity	27,182	25,267	30,762	29,205
Natural Gas	15,504	15,631	15,315	15,614
Transportation (Emissions from miles within city boundary)	13,489	13,484	13,433	13,513
Transportation (Emissions from miles outside city boundary, trips starting or ending in city)	74,560	74,772	74,718	75,395
Solid Waste	4,736	4,622	4,419	4,862
Water	3,052	2,963	3,601	3,553
Wastewater	693	673	621	607
Total (MT CO_2e)	**139,216**	**137,412**	**142,868**	**142,750**

EPIC, 2016

Between 2010 and 2013, the lowest total GHG emissions were generated in 2010 and the highest were generated in 2012.

4 SUMMARY OF METHODS BY CATEGORY

4.1 Electricity

GHG emissions from electricity consumption by the City of Solana Beach were estimated using method BE.2 Emissions from Electricity Use, from the ICLEI Community Protocol.[3] Electricity consumption in the City of Solana Beach was provided by the local utility, San Diego Gas & Electric (SDG&E), for two customer classes: residential and commercial.[4] Two modifications were made to the consumption (Table 3) for this inventory. First, the annual electricity consumption obtained from SDG&E was grossed up using a loss factor[5] of 1.066 to account for transmission and distribution losses.[6] Second, in order to avoid double counting, the portion of electricity consumption associated with the local distribution of water was subtracted from the electricity category and attributed to the water category.

The modified electricity consumption was multiplied by the electricity emission factor for the City of Solana Beach in the given year (Table 3) and expressed in pounds of CO_2e per megawatt-hour (lbs

[3] ICLEI – Local Governments for Sustainability USA. U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. Version 1.0. (2012). Appendix C: Built Environment Emission Activities and Sources. http://icleiusa.org/tools/ghg-protocols/

[4] Communication with SDG&E. Data provided to EPIC on 10/28/2015.

[5] Transmission and Distribution Loss Factor is used to scale end-use demand or retail sales to produce net energy for load. Wong (2011). *A review of transmission losses in planning studies.* CEC Staff Paper. http://www.energy.ca.gov/2011publications/CEC-200-2011-009/CEC-200-2011-009.pdf

[6] California Energy Commission (CEC). *California Energy Demand 2015-2025 Final Forecast Mid-Case Final Baseline Demand Forecast Forms*. SDG&E Mid. Download Date: 06/23/2015. The transmission and distribution loss factor, 1.066, is calculated based on SDG&E Form 1.2 Mid. http://www.energy.ca.gov/2014_energypolicy/documents/demand_forecast_cmf/Mid_Case/

CO_2e/MWh). For a given year, the electricity emission factor in the City of Solana Beach is developed based on the city-specific power mix of SDG&E bundled power[7] and the power provided by other electricity providers – known as Direct Access (DA),[8] and their respective emission factors (lbs CO_2e/MWh). The SDG&E bundled emission factor was calculated using Federal Energy Regulatory Commission (FERC) Form 1[9] and California Energy Commission (CEC) Power Source Disclosure Program[10] on SDG&E owned and purchased power, and U.S. EPA Emissions and Generating Resource Integrated Database (eGRID)[11] on specific power plant emissions. The Direct Access emission factor used here was adopted in CPUC Decision D.14-12-037[12].

The differences in the electricity emission factors in Table 3 reflect the change in power mix in Solana Beach as well as in the entire SDG&E service territory over the years. The emissions factor increased in 2012 compared with previous years. This was due to the shut-down in 2012 of the zero-emissions electricity supply from the San Onofre Nuclear Generation Station (SONGS). The SONGS electricity supply was replaced by other natural gas-fired power plant sources[13] that increased the emission factor.

The total electricity consumption, electricity emission factor, and corresponding GHG emissions in the City of Solana Beach are given in Table 3.

Table 3 Electricity Consumption, Emission Factor and GHG Emissions in Solana Beach (2010 - 2013)

Year	Electricity Consumption (MWh)	Emission Factor (lbs CO_2e)/MWh)	GHG Emissions (MT CO_2e)
2010	89,211	672	27,182
2011	88,991	626	25,267
2012	89,957	754	30,762
2013	87,729	734	29,205

EPIC, 2016

[7] SDG&E bundled power includes the electricity from SDG&E owned power plants and the electricity from its net procurements.

[8] Direct Access Program includes the electricity customers purchased from electric service providers (ESPs) but SDG&E provides transmission and distribution services. http://www.sdge.com/customer-choice/electricity/direct-access-faq

[9] Federal Energy Regulatory Commission (FERC). Form 1- Electricity Utility Annual Report. http://www.ferc.gov/docs-filing/forms/form-1/viewer-instruct.asp. Download Date: 07/20/2015

[10] California Energy Commission (CEC) Power Source Disclosure Program under Senate Bill 1305. http://www.energy.ca.gov/sb1305/ Obtained SDG&E annual report, 2010-2014, from CEC staff on 08/07/2015.

[11] U.S. EPA. eGRID 2012. (2015) http://www2.epa.gov/energy/egrid Download Date: 10/09/2015

[12] Decision 14-12-037, December 18, 2014 in Rulemaking 11-03-012 (Filed March 24, 2011). http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M144/K130/144130487.pdf. The Decision adopts an emission factor of 0.379 MT CO_2e/MW) for direct access electricity purchased from all investor-owned utilities, publicly owned utilities and energy service providers other than PG&E. EPIC converted the emission factor 0.379 MT CO_2e/MWh to 836 lbs CO_2e/MWh as the DA emission factor.

[13] SONGS is partially owned by SDG&E and historically accounted for approximately 15-20% of its power generation. SONGS was permanently closed in 2013 and the energy generation is replaced by other sources, including non-renewable sources, which may increase the emissions factor for SDG&E-generated electricity. https://www.sdge.com/sites/default/files/documents/1390903853/2011%20Power%20Content%20Label.pdf

Electricity consumption in Solana Beach was lowest in 2013 of the years 2010 to 2013, however, the GHG emissions varied due to the changes in the emission factor as show in Figure 2.

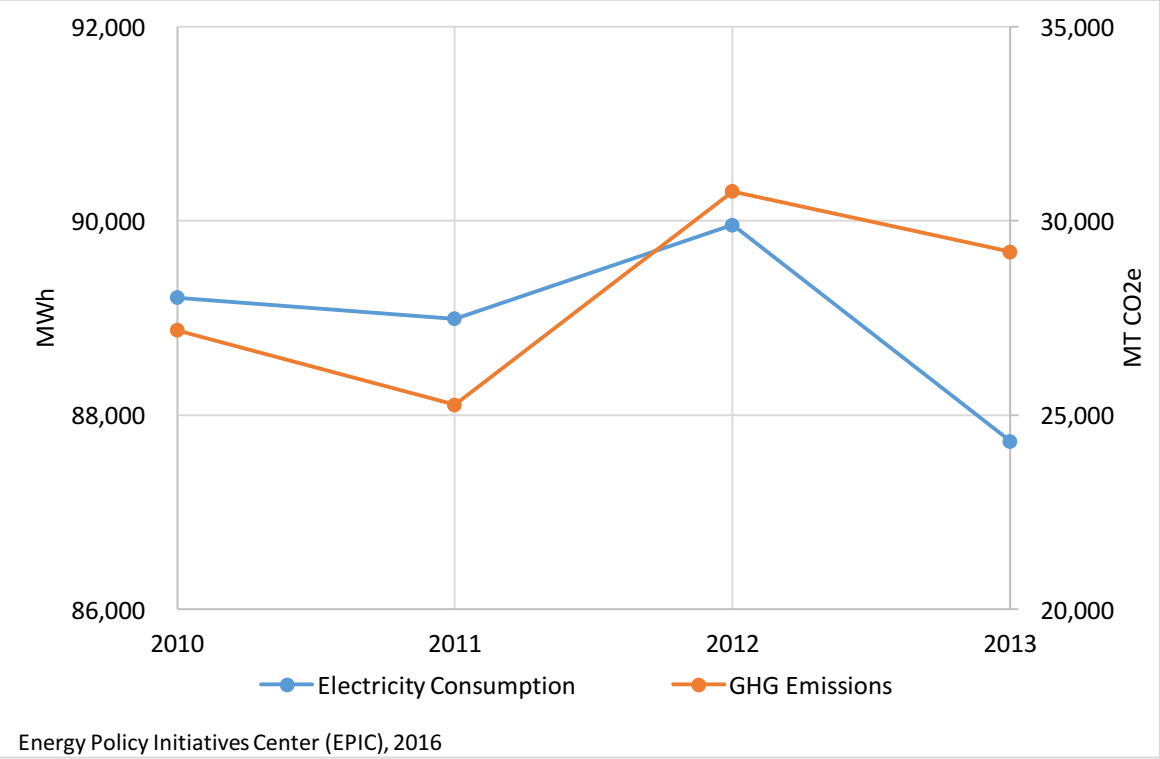


Figure 2 Trends in Electricity Consumption and GHG Emissions in Solana Beach (2010-2013)

These emissions can be broken down further into residential and commercial customer classes. In 2013, 51% of emissions could be attributed to commercial electricity consumption, while 49% came from residential electricity consumption. Figure 3 represents this breakdown in 2013, and the breakdown between commercial and residential customer class in 2010 was also 51% and 49%.

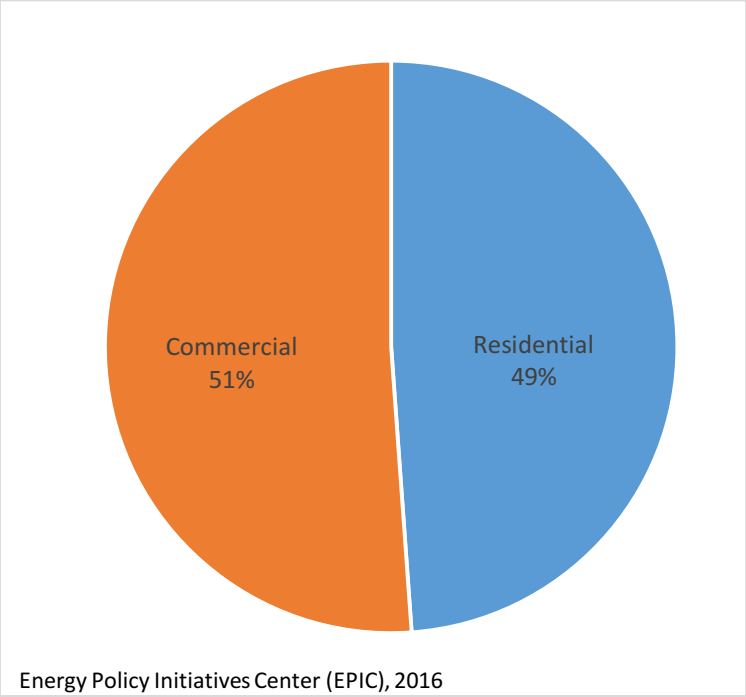


Figure 3 Breakdown of Emissions from the Electricity Category in Solana Beach (2013)

4.2 Natural Gas

GHG emissions from combustion of natural gas for end-use applications in City of Solana Beach were estimated based on method BE.1 Emissions from Stationary Fuel Combustion of the ICLEI Community Protocol.[14] Natural gas consumption in the City of Solana Beach was provided by SDG&E for two customer classes: residential and commercial.[15]

Natural gas consumption was multiplied by the natural gas GHG emission factor, 0.00544 metric ton CO_2e per million therm (MMT CO_2e/MMTherm). For a given year, the natural gas emission factor is calculated based on the heat content of natural gas, fuel CO_2, CH_4, and N_2O emissions from the latest California's Greenhouse Gas Inventory developed by California Air Resources Board (ARB),[16] and GWP of CH_4 and N_2O from Table 1.

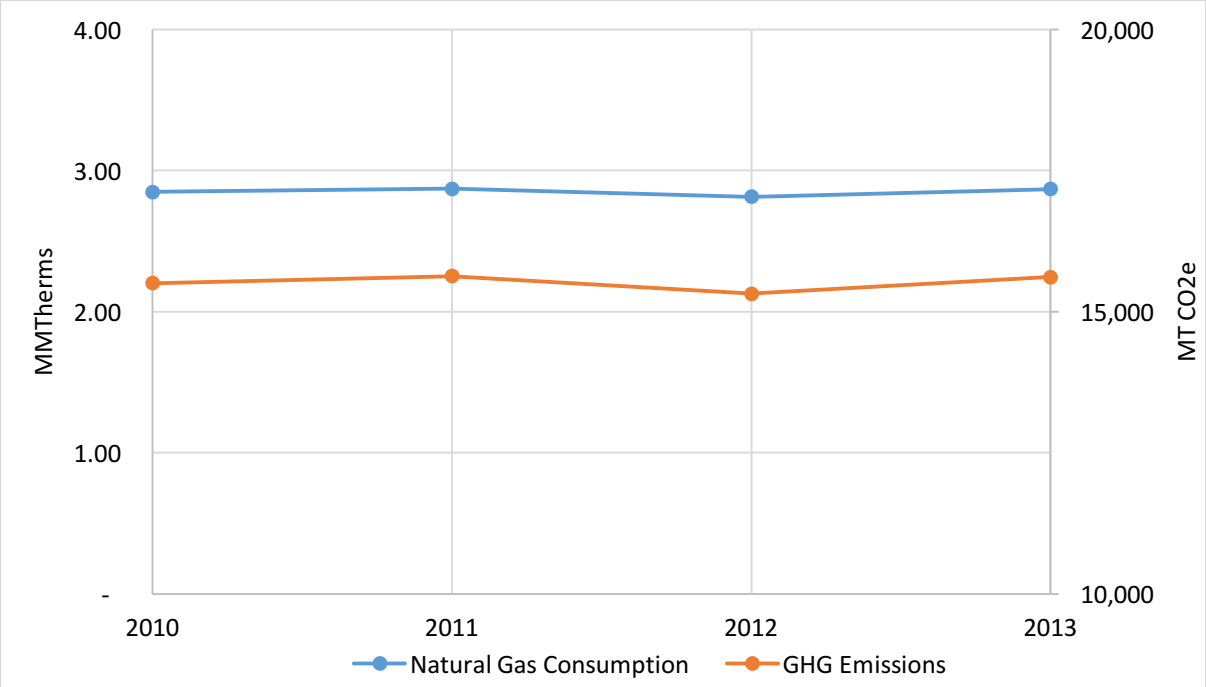
The total natural gas consumption and GHG emissions in the City of Solana Beach are given in Table 4 and the trends are shown in Figure 4.

[14] ICLEI 2012. See Note 3.
[15] Communication with SDG&E. Data provided to EPIC on 10/28/2015.
[16] ARB. 2014. Documentation of California's Greenhouse Gas Inventory. Fuel Combustion – Natural Gas. http://www.arb.ca.gov/cc/inventory/doc/docs1/1a1ai_instategenerationutilityowned_fuelcombustion_naturalgas_ch4_2013.htm

Table 4 Natural Gas Consumption, Emission Factor and GHG Emissions in Solana Beach (2010 - 2013)

Year	Natural Gas Consumption (MM Therms)	GHG Emissions (MT CO_2e)
2010	2.85	15,504
2011	2.87	15,631
2012	2.81	15,315
2013	2.87	15,614

SDG&E, EPIC 2016



Energy Policy Initiatives Center (EPIC), 2016

Figure 4 Trends in Natural Gas Consumption and GHG Emissions in Solana Beach (2010-2013)

Emissions from natural gas can be broken down further into residential and commercial customer classes. In 2013, 26% of emissions came from commercial natural gas consumption, and the remaining 74% can be attributed to residential natural gas consumption. Figure 5 represents this breakdown in 2013. In 2010, the distribution was 25% of emissions from commercial customers, and 72% from residential customers.

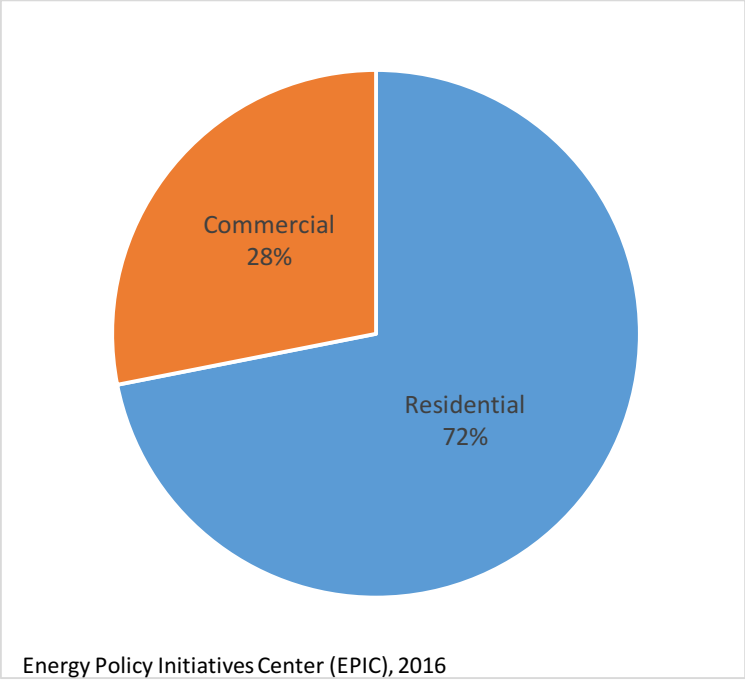


Figure 5 Breakdown of GHG Emissions from Natural Gas Category in City of Solana Beach (2013)

4.3 Transportation

GHG emissions from on-road transportation in the City of Solana Beach were estimated based on vehicle miles traveled (VMT) and the emission rates associated with the total vehicle fleet in San Diego region in a given year. VMT in the City of Solana Beach was provided by San Diego Association of Government (SANDAG), based on the Origin-Destination (O-D) method. The O-D VMT method proposed by the ICLEI Community Protocol estimates miles traveled based on where a trip originates and where it ends to allocate on-road emissions to cities and regions with policy jurisdiction over miles traveled (Figure 6).[17]

[17] ICLEI – Local Governments for Sustainability USA. U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. Version 1.0. (2012). Appendix D: Transportation and Other Mobile Emission Activities and Sources.

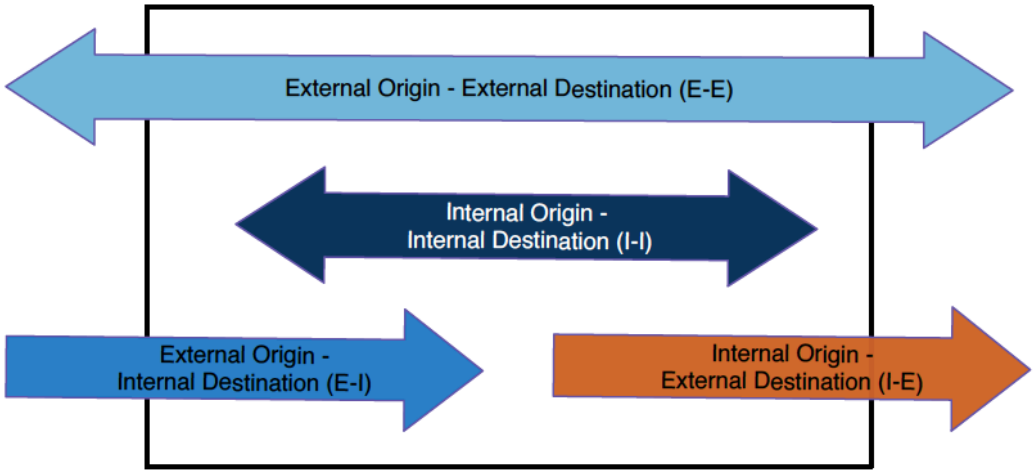


Figure 6 Components of Origin-Destination (O-D) method for Calculation of Vehicle Miles Traveled

O-D VMT include trips that originate and end within the boundary, in this case within the City of Solana Beach geographical boundary (referred to as Internal-Internal), and trips that either begin within the boundary and end outside the boundary (referred to as Internal-External) or vice versa (referred to as External-Internal). VMT from Internal-External/External-Internal trips include both the miles in Solana Beach geographical boundary and outside Solana Beach geographic boundary but within the San Diego region.

VMT from trips that begin and end outside the boundary that were only passing through the City of Solana Beach (referred to as External-External) were excluded. Therefore, emissions from External-External VMT were not allocated to the City of Solana Beach. O-D VMT data for each trip type from 2010 to 2013 are given in Table 5.[18]

Table 5 Original-Destination (O-D) VMT for Trips in Solana Beach (2010-2013)

Trip Type (miles/weekday)	2010	2011	2012	2013
Internal-Internal	27,582	27,803	28,024	28,245
Internal-External/External-Internal (within city boundary)	98,273	99,344	100,415	101,486
Internal-External/External-Internal (outside city boundary)	848,120	859,214	870,309	881,403

SANDAG, 2015

To calculate total VMT, all Internal-Internal VMT were included. External-Internal/Internal-External VMT were divided by two to split the miles evenly between the city and outside jurisdictions. The total VMT were multiplied by 0.96 to adjust from average weekday VMT to average daily VMT including

[18] Communication with SANDAG. Data received on 09/23/2015. VMT data in 2020 and 2013 were provided by SANDAG directly. 2011 and 2012 VMT Data were interpolated linearly.

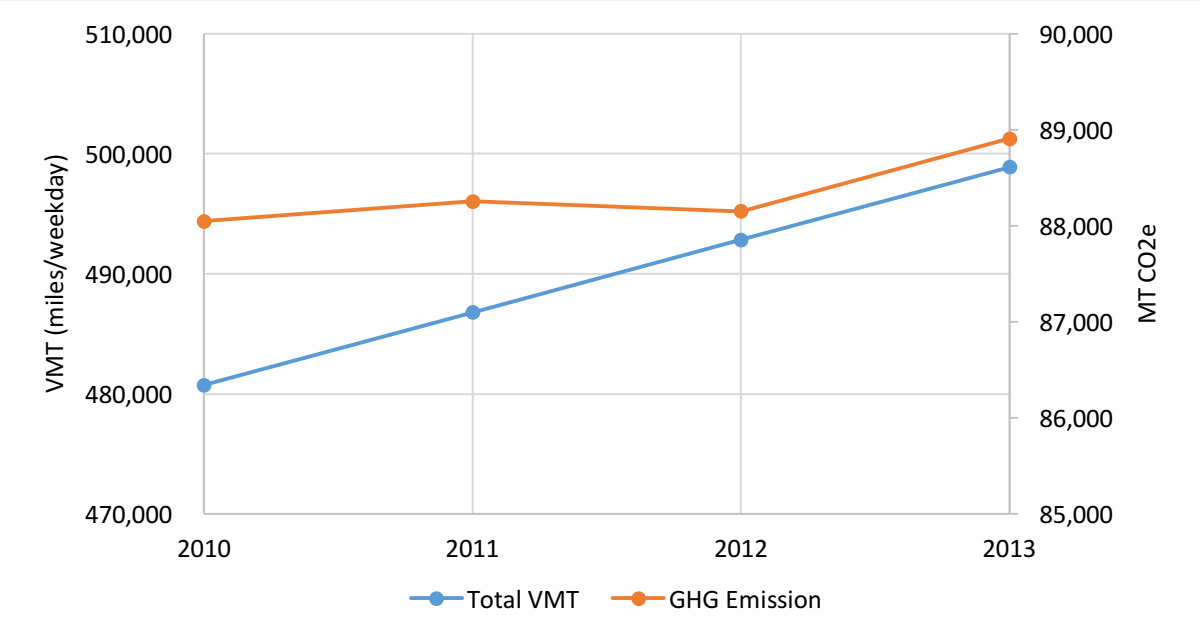
weekends.[19] The percent of VMT that is purely inside Solana Beach's geographical boundary is 15% of total VMT used the inventory.

The emission rate in grams (g) CO_2e/mile was derived from the statewide mobile source emissions model EMFAC2011, developed by California Air Resources Board (ARB).[20] EMFAC2011 was used to generate emission rates for SANDAG on a metropolitan planning organization (MPO) basis, for calendar year 2010-2013 with all vehicle classes (EMFAC2011 Categories), model years, speed and fuel types.[21] The fleetwide g CO_2/mile emission rate was calculated based on the distribution of VMT for each vehicle class and its emission rates, then adjusted to account for total greenhouse gas emissions including CO_2, CH_4 and N_2O. Table 6 summarizes the fleetwide vehicle emission rate, total VMT and GHG emissions, and the trends are shown in Figure 7.

Table 6 Total VMT, Emission Rate and GHG Emissions in Solana Beach (2010-2013)

Year	Emissions Rate (g CO_2e/mile)	Total VMT (miles/day)	GHG Emissions (MT CO_2e)
2010	501.8	480,747	88,049
2011	496.7	486,799	88,257
2012	490.0	492,850	88,151
2013	488.2	498,902	88,909

EPIC, 2016



Energy Policy Initiatives Center (EPIC), 2016

[19] The "5 to 7 day conversion" factor for VMT for freeways and highways, was provided by Caltrans, Kim Sturmer (2009).
[20] California Air Resources Board. Mobile Source Emissions Inventory. EMFAC2011. http://www.arb.ca.gov/msei/msei.htm
[21] EMFAC2011 Web Database. Emission Rates for SANDAG, Calendar Year 2012 and 2013.

Figure 7 Trends in Total VMT and GHG Emissions in Solana Beach (2010-2013)

4.4 Solid Waste

GHG Emissions from the decomposition of organic material in waste disposed at landfills are estimated based on method SW.4 from ICLEI Community Protocol.[22] For emissions from community-generated mixed waste, solid waste disposed by in the City of Solana Beach was multiplied by the mixed waste emission factor[23] to estimate the total emissions. The impact of recycling and composting diversion programs on emissions reduction were not captured in this inventory because the waste disposed data already exclude waste diverted from these programs. The recycling and diversion programs contribute to lowering the amount of community-generated waste sent to the landfills.[24]

Solid waste disposed into landfills from 2010 to 2013 was obtained from California Department of Resources Recycling and Recovery (CalRecycle) Disposal Reporting System (DRS).[25] The total waste disposal was multiplied by mixed solid waste emission factor, 0.06 MT CH_4/wet short ton[26] then converted to MT CO_2e. The landfill gas capture rate was assumed to be 75% based on ICLEI Community Protocol.[27] The total solid waste disposed and post-capture emissions in 2013 are given in Table 7 and the trends are shown in Figure 8.

Table 7 Solid Waste Disposed by Solana Beach and GHG Emissions (2010 - 2013)

Year	Community Solid Waste Disposal (metric tons/year)	Per Capita Solid Waste Disposal (kg/person/day)	GHG Emissions (MT CO_2e)
2010	12,731	2.7	4,736
2011	12,425	2.6	4,622
2012	11,878	2.5	4,419
2013	13,068	2.7	4,862

CalRecycle, EPIC 2016

[22] ICLEI – Local Governments for Sustainability USA. U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. Version 1.0. (2012). Appendix E: Solid Waste Emission Activities and Sources. http://icleiusa.org/tools/ghg-protocols/

[23] ICLEI Community protocol. Appendix E: Solid Waste Emission Activities and Sources. Table SW.5 CH_4 Yield for Solid Waste Components.

[24] ICLEI, 2012. See 22.

[25] CalRecycle. Disposal Reporting System (DRS): Jurisdiction Disposal and Alternative Daily Cover (ADC) Tons by Facility. http://www.calrecycle.ca.gov/LGCentral/Reports/DRS/Destination/JurDspFa.aspx Download Date: 08/03/2015

[26] ICLEI, 2012. Table SW.5. See Note 23.

[27] ICLEI, 2012. See Note 22.

Energy Policy Initiatives Center (EPIC), 2016

Figure 8 Trends in Solid Waste Generation and GHG Emissions in Solana Beach, 2010-2013

4.5 Water

Emissions from water supplied to the City of Solana Beach were estimated based on method WW.14 from the ICLEI Community Protocol.[28] The method accounts for each element of the water system (upstream supply and conveyance, local water distribution, and treatment) individually, using the energy intensity per unit of water for each segment of the water system given in Table 8.

Table 8 Energy Intensity for Each Segment of Water System

Segment of Water System	Energy Intensity (kWh/Million Gallons)
Upstream Supply and Conveyance[29]	9,727
Conventional Water Treatment[30]	684
Local Water Distribution[31]	292

CEC 2006, EPIC 2016

[28] ICLEI – Local Governments for Sustainability USA. U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. Version 1.0. (2012). Appendix F. Wastewater and Water Emission Activities and Sources.

[29] California Energy Commission (CEC), *Navigant, Refining Estimates of Water-Related Energy Use in California* (December 2006).

[30] Conventional water treatment processes include coagulation/flocculation, sedimentation, filtration and disinfection. Energy intensity of standard treatment are calculated based on data from City of San Diego's three Water Treatment Plants, provided to EPIC in 2014. (Value for 2010)

[31] City of San Diego. See Note 30.

95% of the water used in Solana Beach is provided by Santa Fe Irrigation District (SFID) and the rest is provided by Olivenhain Municipal Water District (OMWD). SFID provided the amount of potable and recycled water (million gallons) its facilities treated and distributed for Solana Beach from 2006 to 2012. The water treated and distributed from SFID for Solana Beach is then used to estimate the total water consumption in Solana Beach for 2010 to 2012. The water consumption in the latest inventory year, 2013, was extrapolated from the historical data. Based on the 2010 Urban Water Management Plan from SFID[32] and OMWD[33] no groundwater is supplied to Solana Beach, only surface water and recycled water.

For upstream supply and conveyance emissions, potable water consumption was multiplied by the upstream energy intensity to obtain the total electricity consumption from upstream supply. The electricity consumption was then multiplied by the SDG&E service territory electricity emission factor, which is the best available emission factor for upstream electricity supply to calculate GHG emissions. The SDG&E service territory electricity emission factors from 2010 to 2013 are given in Table 9, which were calculated based on the methods described in Section 4.1 – Electricity. The service territory emission factors are slightly different from the emission factors for Solana Beach (Table 3).

Table 9 SDG&E Service Territory Electricity Emission Factors (2010-2013)

Year	SDG&E Service Territory Electricity Emissions factor (lb CO_2e/MWh)
2010	691
2011	651
2012	763
2013	747

EPIC, 2016

For local water distribution and treatment, both potable and recycled water consumption were multiplied by their corresponding energy intensities. The total electricity use associated with water consumption in a given year was then multiplied by the electricity emissions factor for SDG&E service territory of that year, to get the total GHG emissions associated with water consumption. The electricity and GHG emissions associated with local water distribution are already captured in Section 4.1 - Electricity, so the emissions are deducted from electricity category.

The total water consumption (potable + recycled water) and the corresponding GHG emissions are given in Table 10 and the trends are shown in Figure 9.

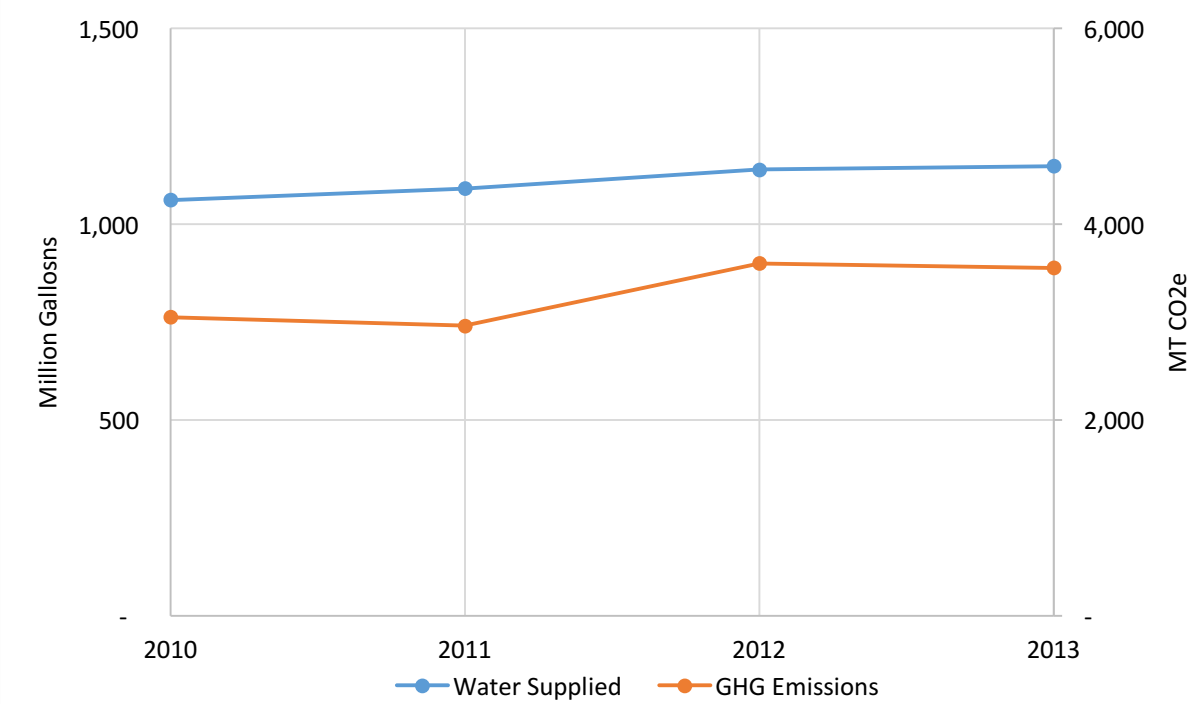
[32] Santa Fe Irrigation District, *2010 Urban Water Management Plan* (June 2011), http://www.water.ca.gov/urbanwatermanagement/2010uwmps/Santa%20Fe%20Irrigation%20District/SFID%20Final%202010%20UWMP_Final_App.pdf

[33] Olivenhain Municipal Water District, *2010 Urban Water Management Plan* (June 2011), http://www.olivenhain.com/files/docs/projects/UWMP/2010%20OMWD%20UWMP.pdf

Table 10 Water Supplied to Solana Beach and GHG Emissions (2010 - 2013)

Year	Community Water Supplied (million gallons/year)	Per Capita Water Supplied (gallons/person/day)	GHG Emissions (MT CO_2e)
2010	1,061	226	3,052
2011	1,091	231	2,963
2012	1,139	241	3,601
2013	1,148	241	3,553

EPIC, 2016



Energy Policy Initiatives Center (EPIC), 2016

Figure 9 Trends in Water Consumption and GHG Emissions in Solana Beach, 2010-2013

In 2013, 90% of the GHG emissions from water consumption were a result of upstream supply and conveyance at 3,215 MT CO_2e. The related breakdown of emissions for the water sector is given in Figure 10. The breakdown was similar in 2010, with 91% of GHG emissions from upstream supply and conveyance.

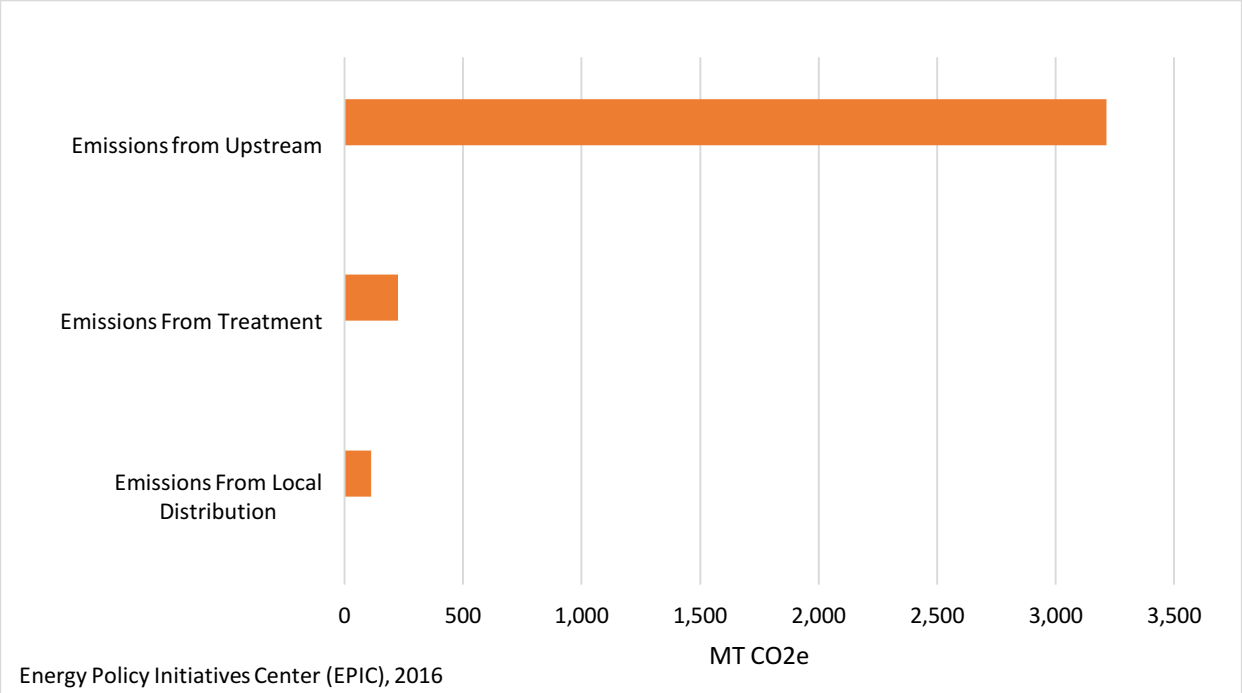


Figure 10 Breakdown of Emissions from Water Category in City of Solana Beach (2013)

4.6 Wastewater

GHG emissions from wastewater generation by the City of Solana Beach were estimated based on the total amount of wastewater generated in a given year, multiplied by the emission factor of wastewater treatment processes. All wastewater generated by the City of Solana Beach is sent to San Elijo Water Reclamation Facility (San Elijo WRF) for treatment. The total wastewater (million gallons) from 2010 to 2014 San Elijo WRF treated for Solana Beach were provided.[34]

Due to the lack of data from the wastewater treatment processes in San Elijo, the emissions from wastewater treatment were estimated using an emissions factor derived from data based on Encina Wastewater Authority, a wastewater treatment plant in the San Diego region using similar treatment processes as San Elijo, as advised by San Elijo staff. In 2013, the Encina Wastewater Authority treated 22.787 million gallons wastewater with GHG emissions of 11,359 metric tons. This results in an emission factor of 1.37 metric tons CO2e/million gallon and consists of emissions from a) biogenic direct, stationary combustion anaerobic digester gas b) process emissions from wastewater treatment with nitrification and denitrification and c) direct anaerobic digester gas. As similar data were not available for the other years, this emissions factor was used as an estimate in other inventory years.

The total wastewater generation, emission factor and GHG emissions are presented in Table 11 and the trends are shown in Figure 11.

[34] Communication with San Elijo Water Reclamation Facility, Data provide to EPIC on 07/29/2015.

Table 11 Wastewater Generation in Solana Beach and GHG Emissions (2010 - 2013)

Year	Community Wastewater Generation (million gallons/year)	Per Capita Wastewater Generation (gallon/person/day)	GHG Emissions (MT CO_2e)
2010	506	108	693
2011	491	104	673
2012	453	96	621
2013	443	93	607

EPIC, 2016

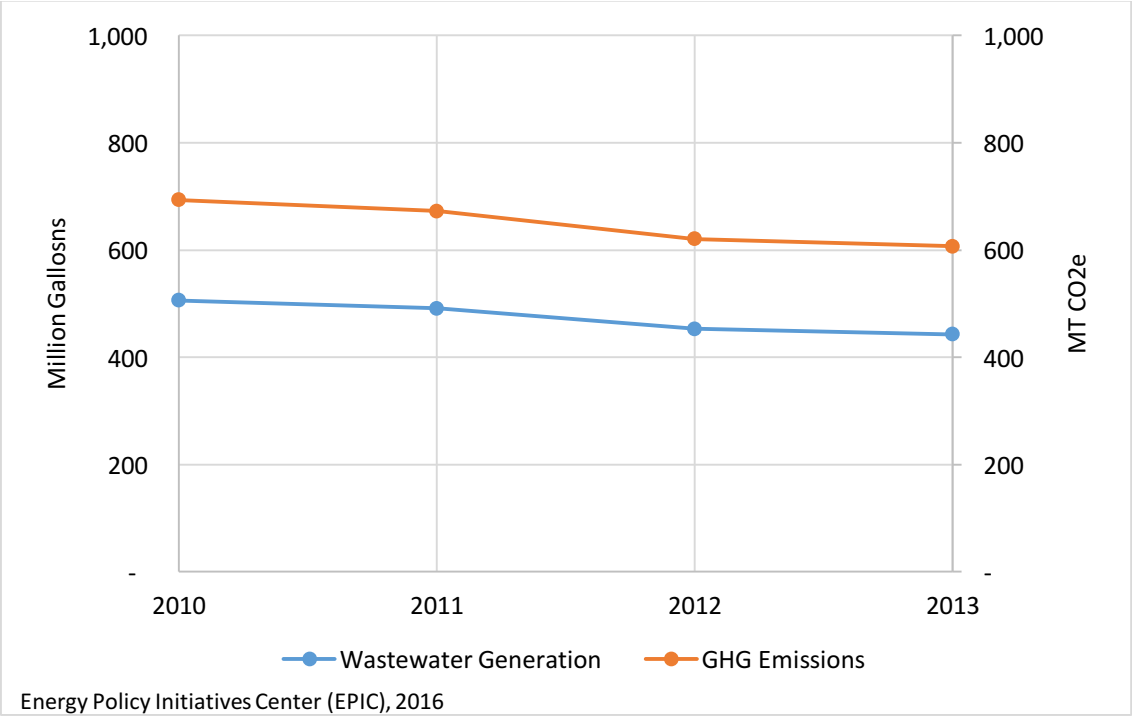


Figure 11 Trends in Wastewater Generation and GHG Emissions in Solana Beach (2010-2013)

5 EMISSION FORECAST TO 2020 AND 2035

GHG emissions inventories provide a retrospective view of emissions within a city; however, to plan for future reduction opportunities, emissions are projected using information about a city's anticipated growth and development but without additional changes to policy after the baseline year. Such projections are often known as business-as-usual (BAU) projections. The total GHG projections are the sum of the emissions projected by category for year 2020, 2030 2035.

5.1 Summary of Emission Forecasts

The total GHG emissions in 2020 were projected at 131,868 MT CO_2e, and the GHG emissions in 2035 were projected at 142,707 MT CO_2e. This is due to the changes in growth and development in each category. Figure 12 below shows a comparison of the emissions breakdown by category for inventory years (2010 and 2013) and forecast years (2020, 2030 and 2035).

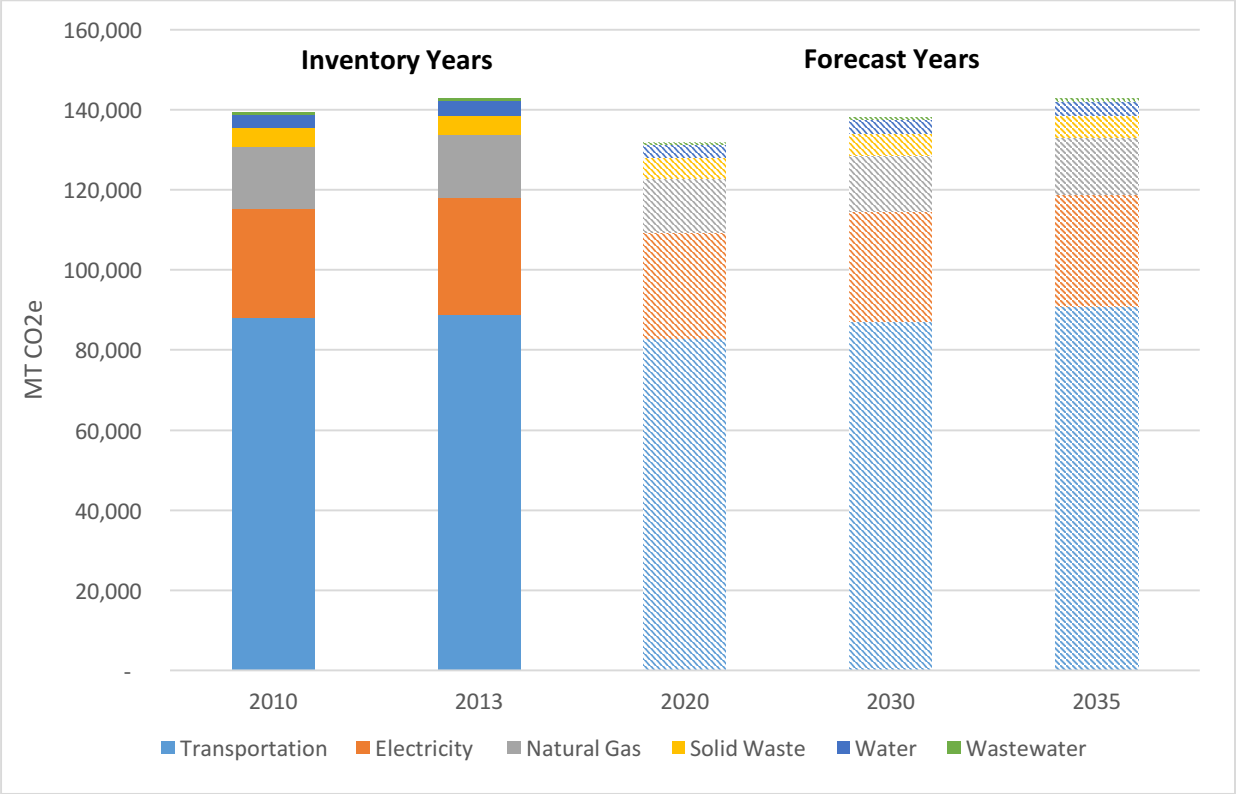


Figure 12 Comparison of Emissions Breakdown by Category in Solana Beach

5.2 Summary of Projection Methods by Category

In general, population and job growth from SANDAG Series 13 Regional Growth Forecast were used for the projection. The population estimates and forecast, and job forecast for City of Solana Beach is given in Table 12.

Table 12 Population Estimates, Population and Job Forecast for Solana Beach

Year	Population[35]	Jobs[36]
2013	13,031	7,642
2020	13,376	8,156
2030	13,971	8,387
2035	14,207	8,533

SANDAG 2013 and 2016, EPIC 2016

[35] Population in 2013 is from SANDAG population estimates (Updated in February 24, 2016). The SANDAG Population Estimates are released annually and modified based on *E-5 Population and Housing Estimates for Cities, Counties and the State*, California Department of Finance. Population in 2020 2030, and 2035 are from SANDAG Series 13 Regional Growth Forecast (Updated in October 2013). Download Date: 03/30/2016 SANDAG Data Surfer. http://datasurfer.sandag.org/

[36] Series 13 Regional Growth Forecast (Updated in October 2013). Number of Jobs in 2013 was interpolated from 2012 and 2020 data. Download Date: 03/30/2016 SANDAG Data Surfer. http://datasurfer.sandag.org/

Each category was projected to 2035 separately using a method specifically for the category. The activity data in the latest year with data available are used.

5.2.1 Electricity

Electricity consumption in the City of Solana Beach was projected separately by residential and commercial customers. For the residential customer class, the per capita electricity consumption in 2014 (3,026 kWh/person/year), the most recent year with SDG&E data, was calculated first by dividing the total electricity consumption in the residential class by the population in 2014.[37] The per capita electricity consumption in 2014 is held constant and used to project total consumption for future years.

For the commercial class, a similar method was used. The total commercial electricity consumption was forecasted based on job growth (Table 12) and the per job electricity consumption in 2014 (5,564kWh/job/year) for all years until 2035.

The total projected electricity consumption was then modified to include losses and exclude the electricity associated with local water distribution. The resulting consumption was multiplied by the Solana Beach specific electricity emission factors in 2014 (the latest year with available data) of 640 lbs CO2e/MWh, held constant, to obtain the total GHG emission for each year until 2035. The total projected electricity consumption and GHG emissions are given in (Table 13).

Table 13 Projected Electricity Consumption and GHG Emissions in Solana Beach (2020, 2030 and 2035)

Year	Total Projected Electricity Consumption (GWh)	GHG Emissions (MT CO_2e)
2020	91,271	26,483
2030	94,548	27,434
2035	96,171	27,905

EPIC, 2016

5.2.2 Natural Gas

The projection method for the natural gas category is similar to that for the electricity category.

The per capita residential natural gas consumption (132 therms/person/year) and the per job natural gas consumption (87 therms/job/year) in 2014 were held constant with population growth for the forecasts. The natural gas emission factor used in Section 4.2 was held constant. The projected total natural gas consumption in the residential and commercial class and the corresponding GHG emissions for forecast years are given in Table 14.

[37] Total population in 2014 is 13,059. SANDAG population estimates for Solana Beach (Updated in February 24, 2016). Download Date: 03/30/2016 SANDAG Data Surfer. http://datasurfer.sandag.org/

Table 14 Projected Natural Gas Consumption and GHG Emissions in Solana Beach (2020, 2030 and 2035)

Year	Natural Gas Consumption (MMTherms)		GHG Emissions (MT CO_2e)	
	Residential	Commercial	Residential	Commercial
2020	1.76	0.71	9,580	3,864
2030	1.84	0.73	10,006	3,973
2035	1.87	0.74	10,175	4,042

EPIC, 2016

5.2.3 Transportation

Vehicle Miles Traveled (VMT) forecast for 2020 and 2035 in the City of Solana Beach were provided by SANDAG. Other intermediate years were interpolated linearly. VMT was multiplied by the adjusted GHG emission rate derived from EMFAC2011 for all years until 2035. For new vehicles entering the fleet after calendar year 2014, including all vehicle classes and fuel types, their emission rate is assumed equal to new model year 2014 vehicles emission rates (calendar year 2014 and vehicle year 2014).[38] The total VMT, adjusted emission rate and corresponding GHG emissions for forecast years are given in Table 15.

Table 15 Total VMT, Emission Rate and GHG Emissions in Solana Beach (2020, 2030 and 2035)

Year	Total VMT (miles/day)	Emission Rate (g CO_2 /mile)	GHG Emissions (MT CO_2e)
2020	505,894	450	82,849
2030	563,491	425	87,150
2035	592,290	422	90,927

EPIC, 2016

5.2.4 Solid Waste

The solid waste disposed by the City of Solana Beach was projected based on per capita solid waste disposal of 2014 (2.9 kg/person/day) and the population growth from SANDAG Series 13 Forecast. Total emissions were calculated by multiplying solid waste disposal and the default mixed waste emission factor and gas capture rate provided in Section 4.4. The projected total solid waste disposal and GHG emissions for the forecast years are given in Table 16.

Table 16 Projected Waste Disposal from Solana Beach and GHG Emissions (2020, 2030 and 2035)

Year	Community Solid Waste Disposal (metric tons/year)	GHG Emissions (MT CO_2e)
2020	14,061	5,231
2030	14,686	5,464
2035	14,934	5,556

EPIC, 2016

[38] Avoid the impact of other vehicle regulations on BAU projection.

5.2.5 Water

The total water supplied to the City of Solana Beach was determined using the same method as in the above solid waste section. The total water supplied to the City of Solana Beach was projected based on the per capita water supply in 2012 (205 gallons/person/day for surface water and 36 gallons/person/day for recycled water), the latest year with data available, and the population growth from SANDAG Series 13 Forecast. The energy intensity for each element of the water system and electricity emission factor in 2014, was used and held constant for all years until 2035. The projected total water supplied and the corresponding GHG emissions for the forecast years are given in Table 17.

Table 17 Projected Water Supplied and GHG Emissions in Solana Beach (2020, 2020 and 2035)

Year	Total Water Supplied (million gallons)	GHG Emissions (MT CO_2e)
2020	1,179	3,244
2030	1,231	3,389
2035	1,252	3,446

EPIC, 2016

5.2.6 Wastewater

The total wastewater generation in the City of Solana Beach was determined using the same method as the solid waste and water sections. The total wastewater generation in the City of Solana Beach was projected based on the per capita wastewater generation in 2014 (92 gallons/person/year), the latest year with data available, and the population growth from SANDAG Series 13 Forecast. The total projected wastewater generation was then multiplied by the wastewater emission factor emission factor used in Section 4.6, (1.37 MT CO2e/million gallon) to obtain the total GHG emissions for all years until 2035.

The projected total wastewater generation and GHG emissions for the forecast years are given in Table 18.

Table 18 Projected Wastewater Generation and GHG Emissions in Solana Beach (2020 and 2035)

Year	Wastewater Generation (million gallons)	GHG Emissions (MT CO_2e)
2020	451	617
2030	471	645
2035	479	656

EPIC, 2016

6 DIFFERENCE FROM 2005 INVENTORY

A GHG inventory was prepared by ICLEI for Solana Beach using previous ICLEI methodology and 2005 data.[39] Emissions were calculated for both government operations and community. For the community inventory, the five categories included in the previous ICLEI methodology were residential, commercial,

[39] City of Solana Beach 2005 Greenhouse Gas Emissions Inventory. http://www.sdfoundation.org/Portals/0/Newsroom/PDF/Reports/SolanaBeachsm.pdf

transportation, solid waste and wastewater, different from sectors in the current ICLEI methodology. The emissions results from previous 2005 inventory (prepared by ICLEI) and current inventory (prepared by EPIC) are provided in Table 19.

Table 19 Total Emissions and Emissions Breakdown by Categories in 2005, 2010 and 2013

Category	2005 Inventory (prepared by ICLEI)	2010 Inventory (prepared by EPIC)	2013 Inventory (prepared by EPIC)
Electricity[40]	20,922	27,182	29,205
Natural Gas	14,861	15,504	15,614
Transportation	109,388	88,049	88,909
Water	Not available	4,736	4,862
Solid Waste	3,981	3,052	3,553
Wastewater	619	693	607
Total (MT CO_2e)	**149,771**	**139,216**	**142,750**

*Highlighted categories cannot be directly compared

EPIC 2016, ICLEI 2011

Total emissions are higher in 2005 than in the current inventories. However, this is due also to differences in methodology between the 2005 inventory and current inventories, therefore a direct comparison of the total emissions from the inventories is not possible. A summary of differences between methodologies in the 2005 inventory and the current inventories by sector is given in the following.

6.1 Electricity

For the electricity sector, the emissions are calculated by multiplying electricity consumption in the community with an emission factor, in both the 2005 and current inventories. However, not only is the consumption as expected, different, but also the emission factor is different. The electricity emission factor used in the 2005 inventory was 547 lbs CO2/MWh for SDG&E electricity and 724 lbs CO2/MWh for direct access electricity (WECC California[41]). These factors were significantly lower in 2005 compared with 2010 and 2013 (Table 3), therefore the total emissions in 2005 were lower as well. In particular, SDG&E's bundled electricity emission factor of 547 lbs/MWhfor 2005 is much lower than the value of 2014, although it is 2014 that reflects the increasing percentages of zero emissions electricity in the mix. Therefore, no statement about trends can be made in this category between the 2005 and later inventories.

6.2 Natural Gas

There are no methodological or emissions factor differences for this category. Therefore the difference between 2005 and 2010/2013 emissions is due to the difference in natural gas consumption.

[40] Even through electricity and natural gas are not one of the five sectors in previous ICLEI, they were calculated separately and given in the report.

[41] WECC, Western Electricity Coordinating Council, one of the eight Regional Entities with delegated authority from North American Electric Reliability Corporation (NERC) and FERC.

6.3 Transportation

For the transportation sector, the methodologies are very different. The current ICLEI method recommends using VMT from trips originated and/or ended within the community boundary, from either an activity-based travel demand model with trip origin and destination data or a trip-based travel demand model with trip origin and destination data (four step models). The activity-based model is to be preferred. In the 2005 inventory, the emissions were calculated based on “local” versus “state” road categories and included miles traveled through the city that the trips neither started nor ended in the city boundary.

Therefore, no statement about trends can be made in this category between the 2005 and later inventories.

6.4 Solid Waste

There are no methodological differences for this category and trends can be observed.

6.5 Water

Emissions from water consumption were not included as a main sector in the previous ICLEI methodology, therefore not included in 2005 inventory. Therefore, no statement about trends can be made in this category between the 2005 and later inventories.

6.6 Wastewater

For the wastewater sector, the methodology in 2005 and current inventory are very different. The emissions from wastewater generation in the 2005 inventory were downscaled from the 2008 San Diego Regional GHG inventory based on the local population. In the current inventories emissions were calculated based on the wastewater generation in Solana Beach and the facility-specific treatment emission factor. Therefore, no statement about trends can be made in this category between the 2005 and later inventories.